The Sky

Day sky: the Sun, occasionally the Moon

Night Sky: stars, and sometimes the Moon
So MANY objects....How Do We Make Sense of it ALL??
Goal

• How to describe the locations of objects in the sky
• To understand the daily and annual motions of the Sun and stars.
Celestial sphere is an imaginary sphere on which the stars, sun and moon appear to reside. It is not real!
The position of a star on the sky is specified by: direction of the star, and the angle of the star above the horizon.
Astronomers measure distance across the sky as angles: in degrees.
Angle diameter (in radians) = diameter/distance

Full circle = $2\pi$ (in radians) = 360 degrees = $360^\circ$

$1^\circ$ = 60 arcminutes = 60’

1’ = 60 arcseconds = 60”
The Sun is physically 400 times larger than the Moon. Why is their angular size the same?
Angular Size

Some Examples:

- Horizon to zenith (point overhead) 90°
- Your fist at arm's length 10°
- Your fingernail at arm's length 1° = 60'
- Sun or Moon seen from Earth 0.5° = 30'
- Smallest detail visible to naked eye 1' = 60"

Smallest detail visible by a single telescope from Earth's surface: 1"
Angular size of Pluto: 0.15"

Betelgeuse (largest star) seen from Earth 0.004"
Thus, stars cannot be resolved
Some objects are brighter than others
Magnitude scales of brightness

- Sun: -27 magnitude
- Full moon: -12 magnitude
- Venus at brightest: -4 magnitude
- Polaris: +2 magnitude
- Naked eye limit: +5.5 magnitude
- Hubble Space Telescope: +28 magnitude
Patterns in the sky

Constellations: apparent associations of bright stars in the sky
They were named by ancient cultures with some imaginations
This 12 constellations are better known; they are located in the zodiac, the annual path of the sun in the celestial sphere.
Constellations

88 official constellations divide the sky into areas with clear boundaries.
The names of constellations are in Latin. But the names of the most bright stars are derived from ancient Arabic.
The original constellations were invented by farmers over 5000 years ago.
Remember that the constellations are not real associations!
Apparent motion of the sky: There are two ways to think about the motion of the sky:
- the C.S. rotates
- or the Earth rotates while the sky sits still.

The real reason is the Earth is rotating about its polar axis.
How long to go all the way around?

1 day
1 week
1 month
1 year
Are there stars in the sky during the daytime?
Latitude and longitude make a convenient coordinate system for locating objects on the Earth.

Day and night are different at different places on the globe.

Equator separates the globe into north and south hemispheres.

The cycle in the sky directly above the equator is the celestial equator, which separates the celestial sphere into north sky and south sky.
The rotation of the earth

The earth rotates once a day about its polar axis from west to east.

The rotation axis almost always points toward the same direction, the Polaris, but not exactly!
The altitude of Polaris above the horizon is approximately the same as the observer's latitude in the Northern Hemisphere.
Time Zones and Universal Time

STANDARD TIME ZONES
Corrected to April 2001
Zone boundaries are approximate
Daylight Saving Time (Summer Time), usually one hour in advance of Standard Time, is kept in some places
Map outline © Mountain High Maps
Compiled by HM Nautical Almanac Office

Standard Time = Universal Time + value from table

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Note: No Standard Time legally adopted
Earth as seen from above the North Pole

Person in California: 8:00 P.M. local time

Cygnus is overhead as seen from California

Andromeda

To the Sun

Person in California: midnight local time

Andromeda is overhead as seen from California

Cygnus

4 hours later
Time

The time for many astronomical events is given in Universal Time (UT), which is (approximately) the local time for Greenwich, England --- the Greenwich Mean Time or GMT.
Daily Cycles of the Sky

Earth's rotation from west to east causes the sun and stars to rise in the east and set in the west daily.

But not everywhere!

Near the poles, the sun rises and sets every half year, and circumpolar constellations such as Ursa Major, never set.
Annual Cycle of the Sun

Axis of rotation

23.5°

June

Sun

December

(Not to scale)
The PRESESSION of the Earth’s axis has a 26,000 year Period.
The constellations along the ecliptic are called the zodiac
What zodiacal constellation *rises* at midnight in June?

- Libra
- Pisces
- Gemini
- Capricorn
What do I want to learn?

- The origin, structure, evolution and fate of the universe
- How astronomers measure distances, ages and masses
- Black holes
- Structure and evolution of galaxies and stars
- ETs
- Constellations